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ENVIRONMENT

Subject:

**Memorandum in Support of Further Characterization of Extent of  
Radiologically Impacted Material in Areas 1 and 2 - West Lake Landfill  
Operable Unit-1, Bridgeton, Missouri**

Date:  
May 18, 2015

Dear Mr. Vann:

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Our ref:  
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On behalf of Cotter Corporation (N.S.L.), ARCADIS US, Inc. ("ARCADIS") submits this Memorandum in Support of Further Characterization of the Extent of Radiologically Impacted Material in Areas 1 and 2 as a proposed supplement to the Addendum to the Phase 1 Investigation Work Plans (the "Memorandum"). The purpose of this Memorandum is to describe the scope and procedures to be used to conduct additional investigation as to the composition, distribution, and extent of radiologically-impacted material ("RIM") associated with Areas 1 and 2 of Operating Unit-1 ("OU-1") at the West Lake Landfill, in accordance with the requirements of Paragraph 49 of the 1993 Administrative Order of Consent ("AOC") for Remedial Investigation/Feasibility Study for the West Lake Landfill NPL Site located in Bridgeton, Missouri ("West Lake" or the "Site"), as amended. This Memorandum proposes to supplement the Gamma Cone Penetration Test ("GCPT") Work Plan Revision 2 dated September 27, 2013 and the Core Sampling (Phase 1B, 1C and 2) Work Plan – Revision 1 dated January 8, 2014, and prior related Addendums No. 1 dated February 11, 2014 and No. 2 dated February 27, 2014, and Phase 1D Revised Addendum, dated May 1, 2015 (collectively, the "Phase I Work Plans"), as well as EPA's letter of April 20, 2015, identifying additional sampling locations, all of which were previously approved by the U.S. Environmental Protection Agency Region VII (EPA).<sup>1</sup>

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<sup>1</sup> Cotter was not part of the initial Phase 1 work and did not review or comment on the prior Phase 1 report before it was submitted to EPA.

Imagine the result

***Scope of Work and Objectives of the Investigation***

As noted in Paragraph 49 of the AOC, Respondents shall have the right to gather any additional data not specified or required under that Consent Order. Because Respondent Cotter anticipates that the gathering of this additional data to complete the work identified in the Phase I Work Plans referenced above will likely require a modification or extension of the schedule, Cotter is submitting this Memorandum to the EPA Project Coordinator in accordance with the requirements of Paragraph 49 of the AOC to explain the basis for the need for the requested additional data described herein and the nature of the requested modification.

The objective of the investigation set forth in this Memorandum is to provide site-specific focused information to augment the scope of the originally designed Phase 1 investigation. While other data to be collected at the Site is intended to provide data necessary to identify the extent of RIM in the southwestern and western portions of Operable Unit-1 (OU-1) Area 1, this Memorandum will emphasize collection of data to aid in the following objectives:

- 1) Improved understanding of the chemical and radiological compositions of Radiologically Impacted Material (RIM), which heretofore has been assumed to consist solely of the Leached Barium Sulfate Residue (LBSR) material;
- 2) Quantitation as to the leachability of radionuclides and the Resource Conservation and Recovery Act (RCRA) alkaline earth metal barium, which is the dominant (by weight) constituent of the LBSR when RIM samples of any origin(s) are subjected to the Toxicity Characteristic Leaching Procedure (TCLP); and
- 3) Improved understanding of distribution and concentrations of RIM within areas of previously identified RIM.

These specific data objectives are further described within the denoted subsections below.

**Improved Understanding of the Chemical and Radiological Compositions of Radiologically Impacted Material (RIM)**

The prior borehole-related sampling, and its associated emphasis on a very limited body of radionuclides, has led to the assumption that all radiologically impacted material (RIM) is LBSR. Analysis of the ratios of the radionuclide-related data (the method used for the earlier radionuclide analysis) is limited in its ability to specifically

identify the origin(s) of the radiological materials. Different radionuclide origins, in turn, have potentially important implications as to the degree of sequestration and retention of radionuclides. By comparison, the proposed analyte list (below), consisting of pertinent inorganic constituents established to be present in potentially additional radiologic materials, will help determine the presence of radiological materials with chemical compositions diagnostically different from the LBSR. These proposed inorganic analytes consist of Target Analyte List (TAL) metals, with a particular focus on:

- Barium
- Calcium
- Magnesium
- Scandium
- Niobium
- Tantalum

As well as anions including:

- Carbonate
- Sulfate
- Fluoride

A suite of radionuclides, including total and isotopic Uranium and Thorium and their pertinent decay products, will also be measured, along with soil pH.

From these data, an improved assessment of the chemical composition of RIM can be completed that may help identify the presence of any non-LBSR material. The identification and evaluation of any non-LBSR material is vital in further assessing the human health and environmental impacts, if any, that could be caused by these non-LBSR radiologic materials, as well as serving to better characterize the RIM more generally for inclusion in the administrative record supporting EPA's remedy selection process.

#### **Constituent Mobility As Measured by the Toxicity Characteristic Leaching Procedure (TCLP)**

The LBSR is distinctive, insofar as it has been subjected to three prior forms of leaching to remove the maximum amount of uranium possible, and, through this effort, any other radiological and inorganic constituents were also largely removed (Harrington and Ruehle, 1959). Consequently, the LBSR material should possess

exceptional retention of both radionuclides and barium, the dominant inorganic constituent of the LBSR matrix and a Resource Conservation and Recovery Act (RCRA) alkaline earth metal. To aid in the assessment of the stability of the LBSR, samples documented to contain the requisite dominant barium and sulfate matrix and the co-associated radionuclides will be subjected to aggressive sampling using TCLP. The measured activities and concentrations of the respective radionuclides and barium will help provide quantified input that can be used in the hydrologic fate and transport models, and to improve the risk assessment regarding this specific form of RIM. Materials having other chemical and radiological compositions will also be subjected to the TCLP so as to help assess their retention of radionuclides.

#### **Improved understanding of distribution of RIM within areas of previously identified RIM**

To properly assess the efficacy of a partial excavation alternative, it is essential to understand the short-range behavior of RIM, based on borehole data. While geostatistical-based approaches, including kriging, can offer useful insights, such an approach is also limited by the need for identification of a mathematical relationship of a given sample (or samples) to a nearby area or material volume, which may not be available in a landfill environment. Assessment of the presence or absence of short-range relationships between samples requires samples to be collected within a small distance, which is one of the purposes of this proposal. Positioning of these samples very close to historic samples will help document the relationship, if any, between these two sample sets.

The seven (7) additional borings intended to satisfy these proposed data objectives are shown in attached Figures 1 and 2, consisting of 3 borings in Area 1 and 4 borings in Area 2. These locations have been precisely placed to assess the presence of previously detected RIM and to then assess its chemical and more comprehensive radiological composition, and/or to help provide improved insight as to the internal distribution of RIM within the general outline of the extrapolated presence of RIM. As previously noted, these additional samples will augment the sampling identified in the Phase I Work Plans as well as the results of earlier investigations of OU-1.

To allow for direct comparison, these proposed additional samples will be collected per the same protocols used for the Phase 1D and upcoming EPA additional sampling investigations. It is expected that the results of this augmented sampling effort will be incorporated with the samples collected during the Phase 1D

investigation (including the additional sampling recently requested by EPA in its April 20, 2015 letter), helping to provide sufficient additional information to not only complete the assessment of the extent of RIM along the southwestern and western boundaries of Area 1, but to offer improved understanding of the internal distribution of RIM and its chemical and radiological composition, with the objective of being able to better ascertain the particular radioactive materials present (including whether or not the material contains LBSR). The results will also provide information needed to conduct additional evaluations of potential remedial alternatives for Areas 1 and 2, as necessary.

#### Field Investigation and Sample Collection and Analyses

It is anticipated that all of the work will be performed in general accordance with the procedures set forth in the Phase 1 Work Plans (Feezor Engineering, Inc., 2014a, b, and c and 2013, EMSI May 1, 2015) and associated documents (e.g., Health and Safety Plans) used for the prior Phase 1 investigations, including the radionuclides and chemical analytes noted above. These samples will be collected at the 7 borehole locations in Area and Area 2 noted on Figures 1 and 2 (specifically, WL-102, WL-106, and WL-114 in Area 1, and WL-209, WL-210, WL-234, and WL-235 in Area 2).

#### ***Reporting and Schedule***

Cotter's objective is to conduct this augmented effort in conjunction with the additional work requested for Areas 1 and 2 in EPA's April 20, 2015 letter, and reporting will be consistent with the reporting for the Phase 1D investigation (including the additional sampling recently requested by EPA in its April 20, 2015 letter). We anticipate that the additional work requested by Cotter should take approximately three days.

***Project Team***

It is anticipated that this effort will be conducted by the same team who are performing the Phase 1D and EPA additional sampling efforts as described in the relevant Work Plan(s).

**References**

Harrington, C. D., and Ruehle, A. E. (editors), 1959, Uranium Production Technology, D. Van Nostrand Company, Inc. New York, New York.

If you have any questions or desire additional information related to this Memorandum, please do not hesitate to contact me.

Sincerely,

ARCADIS U.S., Inc.



Craig Divine, PhD, PG (Texas License #6622)  
Vice President, Principal Hydrogeologist

Attachments:

Figure 1: Cotter Proposed Borings Area 1

Figure 2: Cotter Proposed Borings Area 2